Text of the November 19, 1999 Final Advisory by the Advisory Council on Clean Air Compliance Analysis on the 1999 Prospective Study of Costs and Benefits of Implementation of the Clean Air Act Amendments (CAAA)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

RE: Final Advisory by the Advisory Council on Clean Air Compliance Analysis on the 1999 Prospective Study of Costs and Benefits (1999) of Implementation of the Clean Air Act Amendments (CAAA)

Dear Ms. Browner:

On October 1, 1999, the Advisory Council on Clean Air Compliance Analysis (Council) held a public teleconference to review a draft Agency document, The Benefits and Costs of the Clean Air Act, 1990 to 2010; EPA Report to Congress (U.S. EPA, Office of Air and Radiation and Office of Policy, September 1999) and held a follow-up teleconference on October 15, 1999 to review an October draft of that same document. These two closure meetings represented the culmination of a multi-year series of review meetings during which the Council provided advice to the Agency on the study design, methodologies, and intermediate results. The Council submits this Advisory to complete its review responsibilities as defined in Section 812 of the CAAA.[1]

The Council believes that The Benefits and Costs of the Clean Air Act, 1990 to 2010 is a serious, careful study that, in general, employs sound methods and data. While we do not endorse all details of the study, we believe that the study's conclusions are generally consistent with the weight of available evidence. The Council also appreciates the Agency's responsiveness over the many years of this study's development to advice conveyed by the Council and its technical subcommittees. While the Project Team has not followed our advice in every instance, we believe that they have done a remarkable job on an extremely difficult project.

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[1] Specifically, subsection (g) of CAA §312 (as amended by §812 of the amendments) states: "(g) The Council shall -- (1) review the data to be used for any analysis required under this section and make recommendations to the Administrator on the use of such data, (2) review the methodology used to analyze such data and make recommendations to the Administrator on the use of such methodology; and (3) prior to issuance of a report required under subsection (d) or (e), review the findings of such report, and make recommendations to the Administrator concerning the validity and utility of such findings."

We would, however, like to bring to your attention two major issues that arose in our review of the study. These pertain to the study's measurement of costs and representation of uncertainty regarding costs. Following our discussion of these points, we present suggestions to improve future Prospective Studies. Because of their importance, we would like to highlight these suggestions here:

a) We believe that benefits and costs must be disaggregated by individual provision of the Clean Air Act if benefit-cost analysis is to be useful in informing regulation.

b) Future studies must attempt to quantify uncertainties about regulatory costs, as well as uncertainties about the benefits of regulations. Failure to quantify cost uncertainties may give the impression that costs cannot exceed point estimates.

c) Cost estimates should include tax-interaction effects; i.e., they should reflect the fact that environmental regulations may exacerbate the disincentive effects of the personal and corporate income taxes. This may raise cost estimates considerably.

d) The Agency should revise its estimates of the Value of a Statistical Life.

e) The impact of air quality regulations should be stated in terms of a Net Cost per Life Saved and a Net Cost per Life-year Saved to facilitate comparisons with other health and safety regulations.

f) Attempts should be made to increase the set of ecosystem benefits valued and to improve estimates of the exposure and effects of air toxics.

1. Comments on the Drafts Provided for Council Review

a) The Relationship between Direct and Social Costs of Compliance. Social cost is the type of cost that is most relevant to the evaluation of the 1990 Clean Air Act. However, the draft Prospective Study relies primarily on estimates of the "direct" compliance costs for affected industries or pollution sources. The reliance on direct costs is understandable, since it is more difficult to assess the social costs. At the same time, it is important to articulate clearly and without bias the relationship between direct and social costs.

The Council believes that the study's discussion of this issue lacks balance and is prone to misinterpretation. The study describes in detail two factors that might cause direct costs to overstate true social costs (absence of attention to producer and consumer responses, and the assumption of a static technology). The October review draft contained a discussion of the tax-interaction effect, which can cause direct costs to understate social costs, possibly by a very large amount. In the Council's view, this effect merited discussion in the text and should not be relegated to a footnote. There is now a substantial body of published theoretical

and empirical research that indicates that, under typical conditions, tax-interactions can cause social costs to exceed direct costs by at least 25 percent, and in some cases by 100 percent or more. Table 3-3 further contributes to potential misinterpretation. It explicitly mentions a factor that would cause direct cost to overstate social cost (lack of attention to producer and consumer responses) but fails to mention explicitly the factor (tax interactions) that works in the opposite direction. By minimizing attention to the tax-interaction effect, the study gives readers the erroneous impression that the EPA's use of direct costs is likely to overstate social costs.

Tax interactions occur when environmental regulations exacerbate the distortions in labor and capital markets caused by prior income, profit, or sales taxes. These interactions may result from any regulations that raise production costs and thereby lower the real purchasing power stemming from given real wages. Even "small" regulations can produce significant tax-interaction effects. The Prospective Study fails to indicate the general relevance of these effects. The study states that general equilibrium effects are important where the regulatory action is known to have an impact on many sectors of the US economy. Although this statement is technically correct, it allows for the impression that such general equilibrium effects are unusual. It fails to point out the key finding from the tax-interaction literature: namely, that all regulatory actions have impacts on other sectors (particularly labor and capital markets) and that these general equilibrium impacts, under typical conditions, raise social costs substantially relative to direct costs.

In sum, the Council would urge the EPA to give more attention to the tax-interaction effect in order to achieve a more balanced and straightforward presentation of the relationship between direct costs and overall social cost. This is necessary to avoid giving the false impression that direct costs are likely to overstate social cost.

b) Characterization of Uncertainty with Respect to Cost Estimates. The main results of the first Prospective Study are summarized in a table of costs and benefits that appears both in the Executive Summary and in Chapter 8. Uncertainties about the benefits of the CAAA are nicely illustrated by a lower bound and an upper bound (90% confidence interval). In contrast, the cost of this environmental protection is represented only by a central estimate. (Cost uncertainties are discussed via sensitivity analyses in other tables, but these uncertainties are not combined into an overall set of bounds on the central cost estimate.)

Thus the benefit-cost ratios in that main summary table vary only with uncertainties about benefits. These ratios would vary even more if they incorporated some uncertainty about costs. Since costs are indeed uncertain, the table implicitly understates the true degree of uncertainty about the net benefits of the CAAA.

Even rough representations of uncertainty about these costs would be better than the current implication that costs are certain. One possibility would be to assume a uniform distribution about each element of cost, ranging from 50% to 150% of the central estimate. A second possibility is to show an additional row of benefit-cost ratios where the costs have been multiplied by 1.3 to account for the tax-interaction effect. A third possibility is suggested by reference to the fact that the Retrospective Study produced a central estimate of direct cost equal to $523 billion, while the modeling approach provided welfare effects between $493 billion and $621 billion. Since these bounds are 6% below and 19% above the central estimate, the same percentage bounds could be applied to the central estimate of costs in the Prospective Study. True bounds on costs in the Prospective Study would be preferred, but one of these rough estimates of bounds is better than using no bounds at all.

2. Suggestions to Improve Future Prospective Studies

a) Disaggregate Benefits and Costs by Title or Provision. The Council reiterates its strong recommendation for presenting the benefits as well as the costs of the CAAA by title and, preferably, by provision, in future studies. Without this level of disaggregation, the study cannot be used directly to identify how the CAAA might be improved in the future. The Council recognizes that a thorough disaggregation analysis was not feasible for the current study since resources were not available for exercising several air quality models to create the needed data base for the analysis. Future studies should not be limited in this regard since more universal and versatile platforms for air quality modeling, such as Models-3, are expected to be available. With careful design, using such a system, a small number of additional comprehensive modeling simulations can provide the information needed for a thorough bottom-up assessment of the CAAA benefits by individual title and even by some provisions. If, in the design phase of the next prospective study, it becomes apparent that resources cannot be allocated for these analyses, then an alternative design strategy combining use of top-down or screening model approaches combined with carefully selected essential comprehensive model simulations should be pursued.

b) Characterize Uncertainty about Costs. The costs imposed by air pollution regulations are highly uncertain. For example, the costs of sulfur dioxide abatement under the 1990 Clean Air Act have turned out to be a fraction of what was estimated in 1990. Unfortunately, uncertainty can lead to higher as well as lower costs.

EPA has relied on engineering estimates of abatement costs. Even if these estimates were accurate estimates of the cost of equipment and operating costs, they would understate social costs because of tax-interaction and other effects. EPA needs to discuss and to quantify the following sources of uncertainty:

(1) Uncertainty in the engineering cost estimates.

(2) Costs in addition to the engineering estimates, such as tax-interactions.

(3) Technical change due to the technology forcing that lowers costs.

(4) Changes in the wage rate or prices of materials due to the changes in demand.

c) Include Tax-Interaction Effects in Future Cost Estimates. One of the most important insights to emerge in Environmental Economics in the past 25 years is that regulations, by exacerbating existing distortions in the economy, can have social costs considerably in excess of direct compliance costs. An environmental regulation that raises the price of purchased goods and lowers the real wage will tend to, other things equal, cause a substitution of leisure for labor. This compounds the deadweight loss of the tax system, which, by driving a wedge between the gross and net of tax wages, causes individuals to substitute leisure for labor. This tax-interaction effect can, in some cases, double the costs of a regulation (Goulder et al. 1999, Parry et al. 1999).[2]

It is important for tax-interaction effects to be included in future Prospective Studies for two reasons. First, these costs are real. They represent real losses in output, and they occur even for small regulations. Second, the tax-interaction effect can at least to some degree be offset if the environmental program raises revenues, which are used to reduce the rates of other, distorting taxes. This implies that the costs of a program will depend on how a standard is achieved, which has implications for the choice of regulatory approach. For example, a permit market will have lower social costs if permits are auctioned and revenues recycled than if permits are given away (Goulder et al. 1997; Parry 1997).[3]

d) Revise Mortality Risk Estimates. The Council is uncomfortable with the Agency's use of $4.8 million (1990 U.S. dollars) for the Value of a Statistical Life (VSL) and $293,000 for the Value of a Statistical Life-year (VSLY) to value mortality risk reductions from reduced air pollution. We question the

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[2] Goulder, Lawrence H., Ian W. H. Parry, Roberton C. Williams III, and Dallas Burtraw, 1999. "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting," Journal of Public Economics 72(3):329-360; and Parry, Ian, W. H., R. C. Williams III, and L. H. Goulder, 1999. "When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets," Journal of Environmental Economics and Management 37:52-84.

[3] Goulder, Lawrence H., Parry, Ian W. H., and Dallas Burtraw, "Revenue-Raising vs. Other Approaches to Environmental Protection: The Critical Significance of Pre-Existing Tax Distortions," RAND Journal of Economics, Winter 1997; and Parry, Ian W. H., "Environmental Taxes and Quotas in the Presence of Distorting Taxes in Factor Markets," Resource and Energy Economics, Winter 1997,19:203-20.

appropriateness of the $4.8 million VSL even as a measure of prime-aged individuals' willingness to pay (WTP) for risk reductions, and we question the application of a WTP estimate for prime-aged individuals to a population of older individuals and people who are in poor health. Time limitations did not permit a thorough treatment of this issue prior to completing the first Prospective Study; hence we recommended that the Project Team use the $4.8 million figure. For future studies, however, we recommend that the Agency revisit the literature on the value of mortality risk reductions. The following points should be kept in mind when examining this literature:

(1) It is WTP for risk reductions that is the appropriate concept when valuing the mortality benefits of environmental regulations. The costs of environmental regulations are spread broadly over many individuals who, indeed, are paying for the resulting risk reductions.

(2) Labor market studies measure willingness to accept (WTA) compensation for increased risk of death. This is likely to exceed what people will pay (WTP) for the same risk reductions.

(3) Averting behavior and consumer product safety studies, which are omitted from the current list of 26 studies, do measure WTP. These studies should be considered in the review.

(4) In reviewing studies the population whose preferences are measured should be noted, as should the magnitude of the risk reduction valued. Studies should be identified that measure WTP for risk reductions among the populations that benefit from air quality regulation, especially older people, and that value risk reductions of the same magnitude as those in future Prospective Studies.

(5) There should be well-defined criteria for selecting studies, which are clearly stated and consistently applied. For example, compensating wage studies should adequately control for inter-industry wage differentials; contingent valuation studies should test for sensitivity to scope.

e) Present Cost-Effectiveness Results. Improvements in human health remain a major motivation behind air quality regulation and account for over 90% of the quantified benefits from Titles I-IV of the 1990 CAAA. Reductions in premature mortality, in turn, account for over 90% of these health benefits. Because mortality risk reductions are such a large component of the benefits from air quality regulation, the Council urges the Agency to express the outcomes of the CAAA in terms of: (1) Net Cost per Life Saved, and (2) Net Cost per Life-Year Saved. These are calculated by subtracting the value of non-mortality benefits from costs and dividing the result by: (1) the number of statistical lives saved, and (2) the number of statistical life-years saved.

By taking this approach the Agency would: (1) provide a measure of program effectiveness that avoids the use of flawed measures of VSL and VSLY and, more generally, avoids the controversies surrounding the valuation of mortality risk change; (2) be in line with standard practice in the public health community, where different programs are routinely compared using cost-effectiveness analysis; and (3) facilitate comparisons of the cost effectiveness of various health and safety programs with health-based environmental regulations. The Council feels such comparisons are necessary for improving public decisions about the allocation of society's scarce resources among competing ends.

f) Increase Set of Ecosystem Benefits Valued. The current Prospective Study has made important advances in identifying ecosystem services that can be linked to air pollution, and in trying to value these endpoints. For the purposes of valuation, it is convenient to categorize the impact of pollution on ecosystems as follows: (1) impacts that occur through markets (e.g., impacts of pollution on commercial timber stands or fish populations); (2) impacts that affect recreation (e.g., damage to National Parks from air pollution or to recreational fishing from acid rain); (3) impacts on ecosystems for which people have well-defined non-use values (e.g., damage to forest canopy, the value of reduced fish populations to non-anglers); and (4) other impacts on ecosystem functions and services, not otherwise classified, for example water and nutrient recycling, maintenance of biodiversity, climate stabilization. These indirect and more subtle effects may not be well understood or even perceived by people; yet they may have important impacts on human well being.

Techniques for valuing the first 3 categories of benefits are well-established, but the set of applied studies is sparse. The Agency might consider funding new studies, after determining which categories of benefits are likely to have the largest impact on regulatory decisions. When commissioning studies to measure non-use values, care should be taken in defining: (1) the geographical scope of what is to be valued (for example, are people asked only for non-use values in their state?); (2) the nature of substitutes (i.e., conditions at other locations); and (3) how many endpoints to value at the same time. For example, in regard to this last point, if a regulation to reduce nitrogen oxides (NOx) affects forests through ozone and fish population through acid rain, people should be asked to value the entire package of ecosystem benefits brought about by NOx reduction. Adding up WTP values from individual studies might overstate the value of the NOx reduction program if there are important substitution effects across ecosystem services.

A problem for policy analysis is that the endpoints that affect markets or for which people have well-defined use (recreation) and non-use values (e.g., damages to forests, fish and wildlife populations) do not capture the totality of ecosystem damages associated with pollution control decisions. In particular, they do not capture ecosystem functions and services such as nutrient recycling

and habitat provision. Nor do they capture the more subtle changes in ecosystem functioning that may to lead to non-marginal changes in ecosystem performance. Before these changes can be valued, however, it is essential that ecologists characterize the ecosystem outcomes (or indicators) that are important to ecosystem functioning and then relate these outcomes (or indicators) to particular activities or pollutants. This information is an essential foundation for economic valuation.

g) Estimate Exposure and Effects of Air Toxics. The Retrospective Study and the first Prospective Study do not contain any quantitative benefit-cost analyses of Toxic Air Pollutants (TAP). As the Council's Health and Ecological Effects Subcommittee (HEES) has stated,[4] the Agency does not currently have analytical methodologies available to establish population exposure estimates, or to define realistic risk estimates for the general population. The HEES, with approval by the full Council, suggested an approach to identifying the research and methodological developments needed to overcome these deficiencies. The effort requires coordination with the SAB Executive Committee, various SAB Committees, the Office of Research and Development and Office of Air Quality Planning and Standards. Implementation of the plan of action outlined for the Agency will begin a process that can lead to quantitative estimates of health, and possibly ecological benefits for the next Prospective Study.

3. Conclusion

The purpose of conducting benefit-cost analyses is to improve the efficiency of regulation. The suggestions we have made in this Advisory are designed to help achieve this goal. Increasing the accuracy of benefit-cost analyses will entail measuring certain categories of benefits (e.g., certain ecological benefits, benefits of reduced exposure to hazardous air pollutants) and costs (tax-interaction effects) not included in the current Prospective Study. It will also entail refining estimates of the value of mortality benefits, which continue to dominate the monetized benefits of improved air quality. Of all the suggestions made above, however, we believe that disaggregating the benefits and costs of individual provisions of the CAA is, perhaps, the most important. If our recommendation to provide more disaggregated benefit-cost estimates can be implemented, the specific programs which have the highest potential payoff to society can be more readily identified. We strongly encourage the Agency to make the research investment and analytical commitments required to ensure this objective is met in the next prospective study.

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[4] See HEES Letter Advisories, "The Clean Air Act Amendments (CAAA) Section 812 Prospective Study of Costs and Benefits (1999): Advisory by the Health and Ecological Effects Subcommittee on Initial Assessments of Health and Ecological Effects, Part 1", EPA-SAB-COUNCIL-ADV-99-012 and "Part 2", EPA-SAB-COUNCIL-ADV-00-001.

We thank the Agency for the opportunity to review the first Prospective Study and to make recommendations to improve the methods and data to be used in future prospective studies. We look forward to your response to this Advisory.

Sincerely,

Maureen L. Cropper

Dr. Maureen L. Cropper, Chair
Advisory Council on Clean Air Compliance Analysis
Science Advisory Board

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